SHORT WAVE RADIO AT OHIO STATE

By C. A. PETRY, '29

The Ohio State Radio Club was organized to bond together those members of the student body, and members of the faculty, of the Ohio State University, who were interested in short wave radio communication, and who of their own accord expressed a desire to keep up with the progress and development of radio.

The club was organized in 1924 and 1925, and for three years had for its quarters a room in the rear of a house on W. Frambes Avenue. Those first three years were eventful in the life of the new organization. It was not located on the campus, and was not recognized as a campus organization. It seemed that the building in which they were located was not the place for such an enterprising group of young men, so plans went forward for obtaining a location on the campus, under better conditions.

The club has had, since its organization, a short wave radio station in operation at all times. The station is licensed by the Department of Commerce, and is assigned an official call, W8LT. Operation is permitted on all amateur wavelengths, with a maximum power rating of 1000 watts. Both code and voice transmission is confined to very definite limits. The type of communication is to be experimental, and non-commercial in nature, and the broadcasting of information is also limited.

In 1927 a one-room frame building was erected on the lot immediately west of the Communications Laboratory, and south of the WEAO towers. This building served its purpose admirably and is still in use.

When the club took up these improved quarters, interest was stimulated and the membership grew. There are now nearly thirty members, and regular meetings as well as daily code classes are held in the "shack." Radio has awakened many students to the opportunities which are arising daily in the communications field.

The club has for its purpose the training of radio operators through actual experience in handling a short wave radio station, and through the contacts which membership in such an organization affords. The men who are good radio operators are also well grounded in the engineering field, and are in a position to assume responsibility immediately after stepping out of college. These facts indicate that the Ohio State Radio Club is an important campus organization.

EQUIPMENT IN GENERAL

The club equipment consists of two transmitting sets and one receiving outfit, with the auxiliary apparatus which is necessary to make up a complete station. Two antenna masts provide anchorage for the antenna systems. The two masts are located so that the south WEAO tower can be conveniently used as a third antenna support. The power supply is housed in the generator room of the Communications Laboratory, and is wired underground to the shack, and to the small thesis house near the Radio Club building.

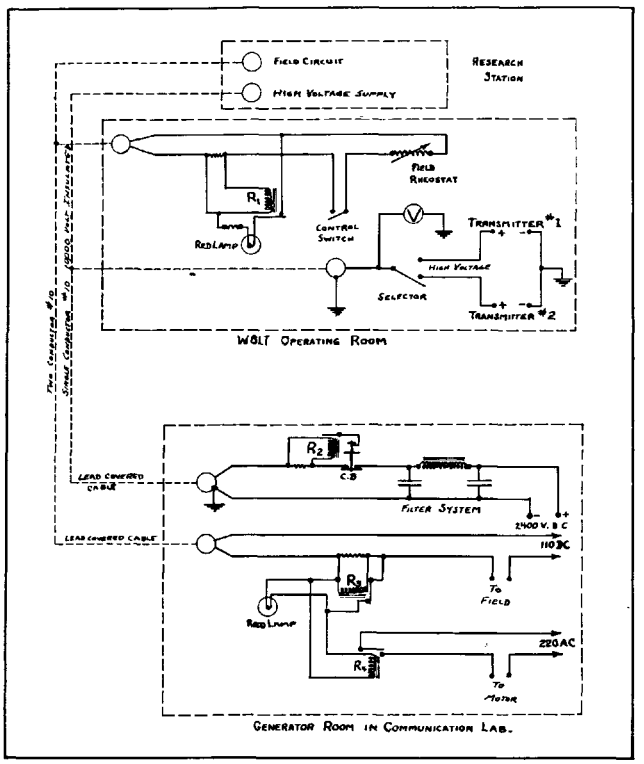

Figure 1.—Wiring Diagram of the Remote Control System and the Power Supply.

Lighting and low-voltage power supply also come underground to the station so that all the space above ground is clear of wires, and is available for antenna systems.

THE ANTENNA SYSTEM

The antenna system comprises a forty-two and eighty-five meter Hertz type antennas, designed and built according to data obtained from a recent thesis by students of the electrical engineering department. These have been found to be far superior to any other type antenna.

One end of each antenna is connected to the south WEAO tower. The other end of each antenna is fastened to one of two, fifty-three foot masts. The lead-in wires are swung from the center position of each antenna to the shack. Long glass tubes insulate these lead-in wires from the framework of the building. A receiving antenna is supported by the east mast and allows for clear reception of distant stations at W8LT.

The east mast is located so that it may be used for research work in the small thesis shack. Last year this mast was used for this purpose entirely; but since the erection of another similar mast it can be made to serve two antennas at the same time.

THE POWER SUPPLY

All radio transmitters require a high-voltage power supply. This often becomes one of the most expensive and most elaborate parts of the station. At W8LT the high voltage is supplied by a 2500-volt motor generator set located in the communications laboratory, and arranged so that

it may be used by the Radio Club, the research shack, or as a stand-by supply for WEAO. This generator is remotely controlled from either the research shack or from W8LT.

Figure 1 shows the wiring of the power supply and control. When the control switch in the operating room is closed, the motor circuit is closed by relays, and the motor-generator set starts up. The beauty of this type of control is simplicity. Relays and resistors are much cheaper than extra control cables; therefore the necessary cables are made to serve in two capacities. By closing the control switch the current required for field excitation is caused to flow in the field circuit of the generators, and through the field rheostat in the operating room. Two small shunt resistances are also included in this circuit, which provide a small voltage drop across relays R_1 and R_3. The current through R_1 and R_3 is sufficient to close the contacts of each relay. R_1 controls the red light in the operating room. R_3 causes a red lamp in the generator room to light, and also causes the motor-starting relay R_4 to close the circuit to the motor. When the motor is up to full speed the voltmeter V, in the operating room, will indicate the voltage available at the contacts of the selector switch. This high-voltage circuit can be closed to either the eighty-five meter transmitter or to the forty-two meter set. The voltage can be varied through wide limits by the rheostat in the operating room.

The relay R_2 is a high-voltage overload circuit breaker. When excessive current flows through the shunt resistor, the circuit breaker is tripped, and the high voltage is automatically disconnected from the power cable. This relay protects the apparatus in the operating room and in the generator room. If a cable fault should occur, this relay opens the circuit. If trouble should occur at the station end, the overload current trips the relay. The great disadvantage is that the operator has to walk over to the generator room, and reclose the circuit breaker. This difficulty is being remedied by an automatic reclosing circuit breaker installation. At the present time another high-voltage circuit breaker is in use at the station end of the cable, which is set to open before the generator circuit breaker opens, in case the trouble occurs at the station. Another relay, which is not shown, opens the high voltage circuit between the selector switch, and the transmitter, in case the transmitter is not started up in the correct sequence. This tends to lengthen the life of the power tubes, since the filament circuit must be closed before this relay operates.

The filter system shown in the diagram is necessary to smooth out the commutator ripple in the high-voltage supply. It consists of two four-microfarad condensers, and a twenty-henry choke coil, connected as shown in Figure 1.

The high-voltage power cable is a single conductor, lead-covered, 10,000-volt cable. The lead sheath is used as the negative conductor, and the core as the positive. This arrangement tends to make the wiring less dangerous and less complicated, since the negative high voltage is grounded at the set end, at all times.

Both the field circuit and the high-voltage cable are taken to the thesis research shack, which is equipped with control similar to that in the operating room of W8LT. The red light in the operating room serves as a warning when the high-voltage generators are being operating from the thesis shack.

THE FORTY-TWO METER TRANSMITTER

The radio telegraph transmitter, which can be operated on either forty-two or twenty-one meters, is a crystal controlled, power amplifier type transmitter. Crystal control provides the basis for a standard frequency signal. W8LT is known as a very reliable station and frequency stability is quite important.

Mechanical systems are known to resonate at definitely defined frequencies, but electrical systems are not stable in oscillation, because of the great number of variables which exist in an electrical circuit. It is important, therefore, to use a vibrating mechanical system to control an electrical system, if frequency stability is important.

In radio transmitters, small plates of quartz are used to control frequency. A voltage applied to the opposite faces of such a plate forms the essentials of a generating system. The oscillations are of constant amplitude and of definite frequency. A quartz crystal in the grid of a vacuum tube controls the frequency of the world's largest radio stations. The small voltages which are generated by this mechanical vibration, at radio frequencies, can be amplified through a system of amplifiers, until they are large enough to control the output of a transmitter.

The crystal oscillator of the forty-two meter transmitter is supplemented by two stages of amplification. The output stage utilizes a 250-watt power tube, which puts 250 watts of power into the aerial.

The amplifiers also act as frequency doublers. The crystal resonates at 168 meters, the first amplifier at 84 meters, and the power amplifier at 42 meters. To operate the outfit on 21 meters,

(Continued on Page 20)

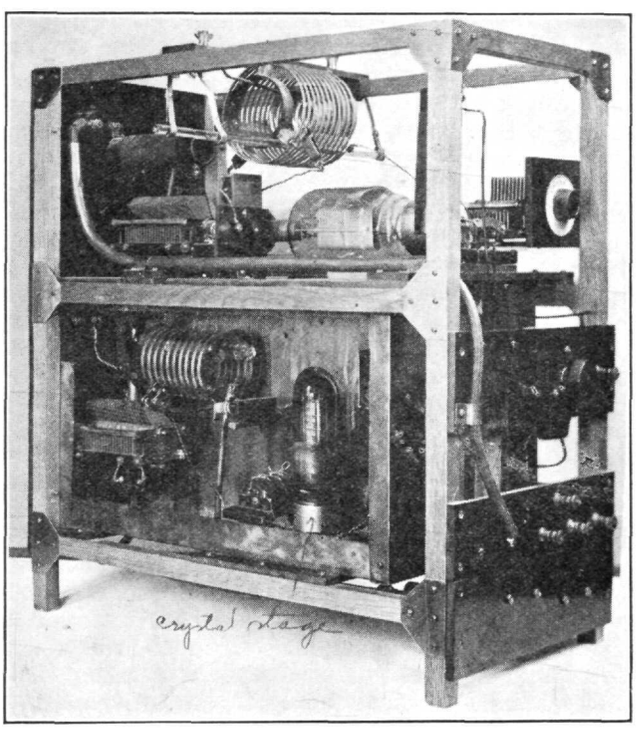

Figure 2.—Side view of the Forty-two-Meter Transmitter.

SHORT WAVE RADIO

(Continued from Page 9)

another amplifier is necessary. This amplifier has become a part of the set, and with a few adjustments the set can be changed over to operate on 21 meters. The 42-meter wave is the better of the two for long distance work at night; but for daylight communication the 21-meter wave is preferable.

Figure 2 shows a side view of the 42-meter transmitter. The lower compartment is the 50-watt crystal oscillator stage. The upper section is devoted to the power amplifier. A 250-watt tube is used in this amplifier. The tuning condensers can be seen behind the front panel. The 50-watt second amplifier stage occupies the other half of the lower compartment. Copper shielding is provided to isolate the amplifiers from each other. The tubular affairs at the back of the set are resistors, to reduce the 2000 volts to a safe operating voltage for the oscillator and first amplifier. The crystal oscillator requires a plate voltage of 400 volts, and the first amplifier requires 1000 volts. The variable condenser at the right rear corner is a neutralizing condenser on the power amplifier stage. The long slender coils are choke coils to keep the high frequency current out of the power supply wiring.

(Continued on Page 22)

SHORT WAVE RADIO

THE EIGHTY-FIVE METER RADIOPHONE TRANSMITTER

(Continued from Page 20)

Pictures of the new voice transmitter are not yet available. The outfit is crystal controlled, and is also of the power amplifier type. There are four units in the actual transmitter, consisting of crystal oscillator and first amplifier on the first unit, the modulated amplifier on the second unit, the modulator on the third unit, and the power amplifier on the last unit. Besides these units there is a three stage audio frequency amplifier which is used for a speech amplifier.

The outfit uses two 7½-watt tubes, one 50-watt tube, one 250-watt tube, two 150-watt tubes, and three speech amplifier tubes. The output is about 350 watts at peak modulation. The latest systems of modulation and the new type screen grid power tubes are being used. This transmitter is still in the experimental stage and will no doubt be improved greatly in the next few months.

Last winter a less complicated and very much inferior voice transmitter was in operation at W8LT. Considerable work was done with this set, and favorable comment was made about the quality of the signals. The new set, in the coming cold winter months, will offer great opportunities for long distance work.

RESULTS

It is very interesting to note that the United States is probably the most tolerant of all countries toward the use of the short wave channels. In many countries the government imposes heavy taxes, and requires licenses to operate either receiving or transmitting equipment. These attitudes toward radio experimenting have retarded the growth of the radio industry and development in these countries while the United States has forged ahead.

W8LT has communicated with nearly every country in the world. Last spring Australian stations were reporting the signals as the most consistent and the loudest of any United States station. The 42-meter set has proved the better long distance transmitter. Very good work was done last winter on 21 meters but nothing has been done this fall on the shorter wave lengths.

The most distant point at which the voice transmitter has been heard was San Francisco, California. This was with the low powered set last winter. No great distances have been worked with the new set because it has not, as yet, had a good try-out.

Tasmania and South Africa, both half way around the earth, have been worked several times. It can be proven that distances greater than 12,500 miles can be worked, but that has no bearing here.

The work at W8LT is not all experimental. Considerable non-commercial message traffic is handled each month. These messages are accepted for transmission to any part of the world, but delivery is not certain because there is no compensation for this service, and amateur stations aften fail to make contacts which will place the message near its destination.

The Ohio State Radio Club is an affiliated club of the American Radio Relay League and plans have been made for joining the Association of College Radio Clubs of America. The short wave work is becoming internationally known and Ohio State can but be happy that this work is being done. For those who are interested in this type of work, and wish a good profitable hobby, affiliation with the Ohio State Radio Club is a splendid opportunity. Visitors are always welcome at the shack. Messages are taken for delivery at distant points and everyone is urged to make use of this service.